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The occurrence of a carbon in ureilite of Almahatta Sitta TC3

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Asteroid 2008 TC_3 exploded in air in the Earth around northern Sudan on October 7, 2008. Its remnants were recovered immediately and called Almahatta Sitta TC_3. Almahatta Sitta TC_3 is a first asteroid we could trace its passage during prior to falling on the Earth after tracing its path in the space by astronomic observation. Almahatta Sitta TC_3 consists mainly of coarse-grained and fine-grained ureilite fragments, OC, EH and EL chondrites. Both ureilites studied by us contain several carbon species. Here, we report the occurrence and nature of the carbon material in them.

The major constituent mineral of the coarse-grained ureilite is olivine (Fa_{18-21}). Minor low-Ca pyroxene, troilite and metallic Fe are also encountered. Raman spectroscopic analyses indicate that fine-grained diamond and graphite exists in the interstices of the olivine grains. The chemical compositions of olivine (Fa_4) surrounding the diamond + graphite assemblages are depleted in Fe compared with those of the olivine (Fa_{18-21}) in a host-rock. Many metallic Fe blebs are contained in the Fe-depleted olivine around the diamond + graphite assemblages. The Fe-depleted olivine and metallic Fe bleb assemblage would be reduction products of olivine by the carbon material.

The petrographic feature of the fine-grained ureilite is much more complicated than the coarse-grained ureilite. The fine-grained ureilite contains olivine, low-pyroxene and metallic Fe but appears to be a conglumerate of different fragments including carbon-bearing clasts. Graphite exists in clasts of metallic Fe. Fibrous graphite is observed on the surface of low-Ca pyroxene or olivine grain adjacent to the metallic Fe. The fibrous graphite might have grown when the metallic iron was molten. Few diamonds could be identified by Raman in few clats in the fine-grained ureilite.

Keywords: graphite, diamond, ureilite